



## Painful Traumatic Trigeminal Neuropathy

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### Introduction

Dental procedures, such as pulpectomy, extraction, implant placement, soft tissue incision or administration of dental local anesthesia (LA), can injure neural tissue and induce neuropathy and/or neuropathic pain. Neuropathy is defined as a functional disturbance or pathologic change in the peripheral nervous system. According to the International Association for the Study of Pain, neuropathic pain arises as a direct consequence of lesions or diseases affecting the somatosensory system.<sup>1</sup> Although the onset of neuropathy can be idiopathic, it is often related to nerve injury or trauma, and is commonly accompanied by pain. The initial, peripheral neuronal damage may lead to functional and structural CNS changes that establish a painful pathologic state.<sup>2</sup> Pain from trauma or iatrogenic injury to the trigeminal nerve remains poorly defined. It has been classified as deafferentation pain, atypical facial pain, post-traumatic neuralgia, and most recently, painful traumatic trigeminal neuropathy (PTTN).<sup>3</sup> This clinical update focuses on the pathophysiology, clinical presentation and management of PTTN.

### Epidemiology

Profound LA likely reduces the impact of peripheral neuronal insult on the CNS. Since dentists are well trained in dental LA technique, this may account for why neuropathic pain is less commonly reported in the dental versus the medical literature.<sup>4</sup> Approximately 3-5% of patients undergoing dental procedures may develop PTTN.<sup>5</sup> The prevalence of PTTN associated with various dental procedures is:

- Third molar extractions:
  - Inferior alveolar nerve (0.3-1.0%); lingual nerve (0.5%)
- Endodontics: (3-13%)
- Implant placement: (0.6-36%)
- Orthognathic surgery: (5-70%)

### Pathophysiology

Injury or insult to the trigeminal nerve may lead to peripheral and CNS structural changes. These peripheral pathological events include inflammation, ectopic neuronal activity, phenotypic neuronal changes, sympathetic nervous system excitation and glial cell activation.<sup>6</sup> The release of inflammatory mediators following nerve injury or insult can lead to altered expression and distribution of peripheral pain receptor (nociceptor) sodium channels throughout the trigeminal nerve pathways including the ganglia. Additionally, novel peripheral adrenergic and calcium ion channels can be expressed along the damaged axons. These changes lower nociceptor depolarization thresholds, affect ectopic neuronal discharges, and lead to peripheral sensitization. Sensitization is a heightened responsiveness to stimuli. When peripheral sensitization persists, nociception barrages 2<sup>nd</sup> and 3<sup>rd</sup> order neurons that feed the thinking circuits of the brain where pain is interpreted. These barrages cause central sensitization and induce hyperalgesia (exaggerated pain response to a painful stimulus) and allodynia (perception of pain to a non-painful stimulus such as light touch). Tissue injury impulses from the shoulders, neck and head reach the brain via the trigeminal nerve system (CN V). Muscle fatigue input as well as persistent nociception can contribute to CN V sensitization.<sup>6</sup> Central sensi-

zation also induces expansion of the injured area's receptive field, causing the perception that pain is spreading to neighboring areas.<sup>7</sup>

### Clinical Presentation

The most common clinical presentation of PTTN is a complaint of persistent pain with or without disturbed sensation. The signs and symptoms usually develop within 3 months after the insult and are localized to the injured dermatome. When central sensitization is present, the injured receptive field can expand to include adjacent dermatomes. PTTN may present clinically as a combination of spontaneous and evoked pain with or without positive (paresthesia, allodynia) and/or negative (sensory loss, anesthesia) symptoms. The pain intensity of PTTN is often reported as moderate to severe (5-10/10 on a visual analogue scale) with possible burning and paroxysmal, stabbing pain. According to Benoliel, the diagnostic criteria for PTTN include the following.<sup>8</sup>

- CN V mediated spontaneous or touch evoked pain
- Pain development within 3 months of trauma
- At least 1 positive or negative sensory sign
- Imaging suggests a trauma evoked cause
  - RCT, implant nerve impingement
- Pain not attributed to another disorder

### Risk Factors & Prevention

Predictive risk factors for PTTN may be patient (genetic predisposition) or treatment (type and amount of trauma) specific. Nixdorf et al. found 3 significant predictors for persistent ( $\geq 6$  months) pain in over 400 patients who received root canal treatment; this included pre-existing (pain duration, patient fear and expectation of a less than ideal treatment outcome).<sup>9</sup> In a retrospective study of 175 patients, the duration of pre-operative tooth pain  $\geq 3$  months, a positive history of previous chronic pain or painful treatment in the head/neck region and female gender had a significant association with persistent odontogenic pain after successful RCT.<sup>10</sup> The presence of central sensitization may pose a risk for developing neuropathic pain following CN V injury. Potential causes for central sensitization include chronic trigeminal mediated pain conditions (TMD, headache, cervicgia), ANS arousal (depression, anxiety, PTSD), other non-trigeminal mediated body pain sources and persistent poor sleep quality.<sup>11</sup>

A thorough understanding of the potential factors that can cause PTTN can help identify patients who may be at risk to develop the neuropathy. Profound LA prevents the barrage of nociceptive input from the periphery to the CNS and reduces the development of peripheral and/or central sensitization.<sup>12</sup> Ensuring profound LA for the entire dental procedure and perhaps during the immediate post-treatment period can help prevent PTTN. Knowing the patient's medical history (PTSD, TBI, depression, anxiety and fear) and explaining procedures and treatment outcomes to minimize unwarranted expectations are important pre/intraoperative considerations to reduce the potential for PTTN.

### Management

A 50% or greater reduction of pain intensity and/or frequency is considered therapeutic success with the management of chronic pain ( $\geq 3-6$  months) conditions.<sup>13</sup> A 30% decrease in neuropathic

pain intensity reflects meaningful pain relief.<sup>14</sup> When PTTN is diagnosed, it is paramount to educate the patient about neuropathic pain and provide information regarding realistic prognosis and management.

Dental LA may be used to: (1) diagnostically assess to what degree PTTN symptoms are driven by peripheral injury or by central sensitization and (2) therapeutically manage symptoms. If a dental LA injection resolves any of the PTTN symptoms, application of a topical medication (20% benzocaine gel) may be an effective treatment option. When the dental LA injection fully relieves the PTTN pain, periodic administration of a long-acting dental LA may eventually abort nociception from the peripheral source. Systemic neuropathic pain medications to address the central sensitization component of PTTN may greatly ameliorate the patient's pain.<sup>12</sup>

Neuropathic pain pharmacotherapy includes anti-epileptic drugs (AEDs), serotonin norepinephrine reuptake inhibitors (SNRIs) and tricyclic antidepressants (TCAs). These adjunctive medications have been shown to be effective for the management of neuropathic pain.<sup>15</sup> The selection of an AED, SNRI or TCA is based on the patient's medical profile. Combination therapy with neuropathic pain medications from different classes may provide additional efficacy by addressing different mechanisms of action and decrease side effects by using lower dosing.<sup>16</sup> Figure 1 lists common medications employed for neuropathic pain management. Providers should be familiar with these medications and their side effect profile before prescribing. The efficacy of opioids and/or NSAIDs for neuropathic pain has not been substantiated by the neuropathic pain literature.<sup>17</sup>

The identification and subsequent reduction of unnecessary peripheral CN V mediated nociceptive & muscle fatigue input should also be considered part of PTTN management. This noxious input may contribute to CN V sensitization and contribute to PTTN symptoms. Examples of nonfunctional CN V mediated nociceptive & muscle fatigue input may include day/night-time excessive tooth contact, non-neutral mandibular, tongue, head & neck posturing and work space ergonomics. Inquiring about sleep quality, other body pain sources and persistent ANS arousal (stressors, anxiety, depression, PTSD) may help identify factors that can negatively influence PTTN through central sensitization.<sup>18</sup>

Surgical intervention is a treatment option for PTTN. Most surgical studies report sensory improvement; only a limited number address pain accompanying nerve damage.<sup>19</sup>

## Conclusion

Dentists should be cognizant of PTTN and understand the steps to take for its prevention and management. Although most injuries from dental procedures recover well with no residual problems, a small percentage may present with PTTN. Referral to an orofacial pain specialist is recommended, if possible. The Orofacial Pain Center in Bethesda, MD (301) 295-1495 is available for consultation and/or referral.

## Take home points:

- Identify, & when possible, reduce pre-existing risk factors
- Ensure profound dental local anesthesia
- Early appropriate post-operative pharmacotherapy
- Consult/refer for pain management in a timely manner

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Drug / Class	Initial dose	Titration	Schedule	Maximal dose
<b>Amitriptyline (Elavil) / TCA</b>	10 mg	10 mg every 2-4 days	Bedtime	75 mg
<b>Nortriptyline (Pamelor) / TCA</b>	10 mg	10 mg every 2-4 days	Day/Night	75 mg
<b>Gabapentin (Neurontin) / AED</b>	100 mg	100 mg every 3-4 days	TID	3600 mg
<b>Topiramate (Topamax) / AED</b>	25 mg	25 mg every 3-4 days	BID	400 mg
<b>Duloxetine (Cymbalta) / SNRI</b>	20 mg	20 mg every day	BID	60 mg

Figure 1: Drugs commonly used for PTTN management